

24 August 1958  
CIA/RR GS 59-15STRATEGIC SIGNIFICANCE OF THE GRAVITY METER

Until the need for accurate intercontinental positioning was recognized several years ago, the gravity meter was chiefly of practical importance to the prospector searching for oil. Technological improvements in the design and assembly of the instrument, notably within the past decade, now make it possible to obtain gravity values of high relative accuracy with a light-weight meter which is easily transportable. Although in past use the gravity meter was limited to the land surface of the earth it is now being successfully adapted by the US and West Germany for use on surface vessels in moderate seas. US research currently in progress seems to assure the ultimate successful employment of the gravity meter in aerial flight. The outlook of securing gravity data from all parts of the earth at acceptable costs and within reasonable time limits significantly increases the technical means for making a precise determination of the shape of the earth. It is this potential improvement in knowing the shape of the earth as it affects (1) the accuracy of intercontinental positioning and (2) the flight of missiles that now makes the gravity meter a very special precision instrument with strategic significance.

The Soviet Union, more than any other nation has stressed the application of gravity determinations in the development of their national horizontal control net. The very comprehensive program of gravity measurement begun by the Soviets in 1932, involved more than 20,000

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stations in the USSR. This work was largely accomplished with pendulum-type instruments of sufficient accuracy for a preliminary survey but which are not dependable by current standards. The Soviets first undertook the construction of spring-type gravity meters about 10 years ago, when they attempted to copy the Norgaard gravity meter. Soviet literature indicates that these early attempts to copy and improve a foreign instrument were not very successful. Troublesome drift rates that required temperature controls and protective casings were encountered. Drift is the inescapable factor present in the operation of every gravimeter, and allowance for drift must be made for each gravity observation. From technical papers, it became evident that the Soviets seem to have had their share of troubles with the drift problem. We believe that the Soviets have failed to achieve recent advances comparable to those which Western nations have enjoyed in improving the gravity meter for use on surface vessels and in aircraft for in-flight surveys. The Soviets have even resorted to the time-consuming and awkward development of a pendulum for surface ship observations, a phase of development bypassed in the US development of spring-type meters. Our suspicion of Soviet inability to match the quality of Western gravimeters was further corroborated by the apparent urgency of Soviet attempts within the past few years to obtain gravity meters from the West. Under pretext of need to use identical US gravity meters for IGY work in the Arctic, the Soviets made their first bid for US Worden gravity meters in 1957. Since then, repeated efforts have been made to purchase gravity meters from US firms by representatives of the USSR and Sovbloc nations. While

manifestly concealing the true state of the art of gravity-meter building in the USSR today, the Soviets persist in continuing their efforts to acquire Western gravity measuring equipment. We believe that the Soviets anticipate a gain from the disassembly of such instruments as they might acquire from the West. The examination of the sealed-in inner components and their composition and probable order of assembly might indeed help the Soviets considerably in overcoming defects in the design and operation of their gravity meters.

The most advanced Soviet land-gravity meter with which we are familiar is the type known as GAE-2. This is still a modified Mergaard instrument, with design features suggested by Molodenskiy and Bulanzhe. Another type strikingly resembling the Worden meter appeared in an advertisement in Hungary more than a year ago. It appeared to us then that the photo was a retouched duplication of a photo of the Worden instrument, but with the identifying name plates obliterated by a lithographic artist. It seems quite probable that in design the Soviets have gone beyond the GAE-2 type instrument but that they are finding troublesome variations in the performance of their instruments. Perhaps no more than a dozen men in the US have the training and experience necessary to produce and assemble the sensitive inner mechanism of a geodetic gravity meter. With less background in the field of precision instrument manufacture, the USSR may not have attained the same level of skill on the part of their instrument builders.

Much Soviet effort is currently going into the improvement of the gravity meter designed for use on board vessels at sea. Essentially

the same sensitive quartz-spring type of gravity meter that is used on land is used for this purpose, but much auxiliary apparatus is required to produce a stable platform to measure the extraneous accelerations produced by the motion of the vessel. The Soviets have been employing pendulums in pairs to try to measure these extraneous accelerations. The problem is obviously a difficult one that calls for much additional research to establish the reliability of the collected data. There are also definite indications of Soviet interest in developing gravity meters for use in airplanes.

To make Western gravity meters available to the Soviets or to Sovbloc countries at this time would indeed be giving them an opportunity to deduce certain trade secrets and technological "knowhow" that required years to develop in the West. To deny Western built gravity meters to the Soviets would very probably retard Soviet progress in this field and help maintain unchallenged our present estimated superiority in the art of building a precision gravity meter. Denial would also delay Soviet progress in the completion of a world gravity survey and, at the same time, improve the US bargaining position to secure gravity data on the USSR, which is now withheld.